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Nodal Distances in Acoustics

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NODAL DISTANCES IN ACOUSTICS

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Our elementary texts discuss the nodal planes produced by two plane waves of the same amplitude and frequency travelling in opposite directions and leave us with the impression that the distance between nodal surfaces is usually one-half of the wave length. Yet this is far from the truth. Nodal surfaces having such a distance apart exist only for plane waves, the most common case being the standing waves in pipes. The purpose of this note is to call attention to a case wherein the distance from a nodal to a loop surface can be made very short, almost as short as you please, and thus to contribute to a greater clearness of understanding.

Consider the case of a conical horn used as a receiver and closed at the vertex. The horn is approximately one-half a wave length of the resonating frequency, yet it has a node at the vertex and a loop at the open end. Now cut a tip off the vertex. There are now two loops, one at each end, and the node very close to the one at the incomplete vertex. Here then, is a nodal surface inside a conical horn which can be brought very close to a loop surface, indeed within a certainly very small fraction of a wave length. Moreover there is in the one instrument a nodal surface at two widely different distances from two loop surfaces, showing the possibility of having a distance from node to loop either less or greater than one-fourth of a wave length. A distance between nodal planes not one-half wave length can be secured by using an overtone.

To put the general statement a little more bluntly, a nodal surface is produced by opposition of phase with equality of amplitude, and traversing a distance is only one of the ways of producing the appropriate changes in phase. No limitation can be placed on the forms of apparatus which will give nodal surfaces separated at distances other than half a wave length.

Moreover, it may be added that one cannot expect that the difference in phase between two points in any kind of enclosure, room or otherwise, is determined by the wave length only.

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